

# Chapter 2

## Causes and Consequences of Urban Growth and Sprawl

### 2.1 Introduction

An overall idea about urban growth and sprawl has been provided in Chap. 1. This chapter is aimed to list the causes and consequences of urban growth and sprawl. The causes that force growth in urban areas and the causes that are responsible for undesirable pattern or process of urban growth are also essentially important for the analysis of urban growth. The consequences or the impacts of urban growth, whether ill or good, are also necessary to be understood and evaluated towards achieving a sustainable urban growth.

Galster et al. (2001) argue that sprawl as a pattern or a process is to be distinguished from the causes that bring such a pattern about, or from the consequences of such patterns. This statement clearly says that analysis of pattern and process should be differentiated from the analysis of causes and consequences. Remote sensing data are more widely used for the analysis of pattern and process rather than causes or consequences. However, some of the researchers (e.g., Ewing 1994) argue that impacts of development present a specific development patterns as undesirable, not the patterns themselves. Therefore, whether a pattern is good or bad should be analysed from the perspective of its consequences. Causes are also similarly important to know the factors that are responsible to bring such pattern. Indeed remote sensing data are not enough to analyse the causes or consequences in many instances; one should have clear understanding of causes and consequences of urban growth and sprawl to encounter the associated problems.

### 2.2 Causes of Urban Growth and Sprawl

The causes of urban growth are quite similar with those of sprawl. In most of the instances they can not be discriminated since urban growth and sprawl are highly interlinked. However, it is important to realise that urban growth may be observed without the occurrence of sprawl, but sprawl must induce growth in urban area. Some of the causes, for example population growth, may result in coordinated compact growth or uncoordinated sprawled growth. Whether the growth is good or bad

**Table 2.1** Causes of urban growth which may result in compact and/or sprawled growth

Causes of urban growth	Compact growth	Sprawled growth
Population growth	•	•
Independence of decision		•
Economic growth	•	•
Industrialisation	•	•
Speculation		•
Expectations of land appreciation		•
Land hunger attitude		•
Legal disputes		•
Physical geography		•
Development and property tax		•
Living and property cost		•
Lack of affordable housing		•
Demand of more living space	•	•
Public regulation		•
Transportation	•	•
Road width		•
Single-family home		•
Nucleus family	•	•
Credit and capital market		•
Government developmental policies		•
Lack of proper planning policies		•
Failure to enforce planning policies		•
Country-living desire		•
Housing investment		•
Large lot size		•

depends on its pattern, process, and consequences. There are also some of the causes that are especially responsible for sprawl; they can not result in a compact neighbourhood. For example, country-living desire—some people prefer to live in the rural countryside; this tendency always results in sprawl. Table 2.1 lists the causes of urban growth, and shows which of them may result in compact growth and which in sprawled growth.

The causes and catalysts of urban growth and sprawl, discussed by several researchers, can be summarised as presented in the following sections (for a general discussion one may refer Burchfield et al. 2006; Squires 2002; Harvey and Clark 1965).

### ***2.2.1 Population Growth***

The first and foremost reason of urban growth is increase in urban population. Rapid growth of urban areas is the result of two population growth factors: (1) natural increase in population, and (2) migration to urban areas. Natural population growth

results from excess of births over deaths. Migration is defined as the long-term relocation of an individual, household or group to a new location outside the community of origin. In the recent time, the movement of people from rural to urban areas within the country (internal migration) is most significant. Although very insignificant comparing the movement of people within the country; international migration is also increasing. International migration includes labour migration, refugees and undocumented migrants. Both internal and international migrations contribute to urban growth.

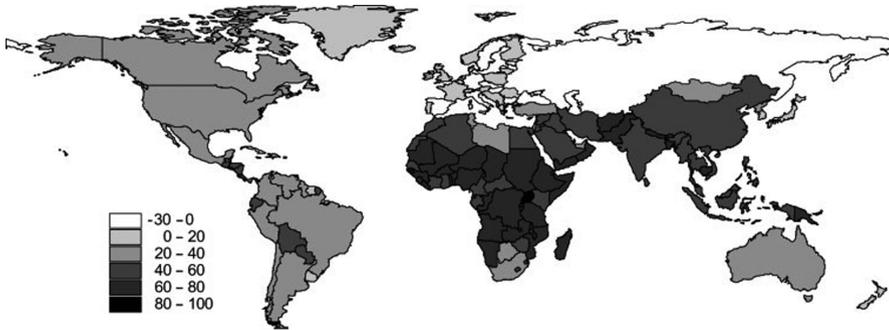
Internal migration is often explained in terms of either *push factors*—conditions in the place of origin which are perceived by migrants as detrimental to their well-being or economic security, and *pull factors*—the circumstances in new places that attract individuals to move there. Examples of push factors include high unemployment and political persecution; examples of pull factors include job opportunities or better living facilities. Typically, a pull factor initiates migration that can be sustained by push and other factors that facilitate or make possible the change. For example, a farmer in rural area whose land has become unproductive because of drought (push factor) may decide to move to a nearby city where he perceives more job opportunities and possibilities for a better lifestyle (pull factor).

In general, cities are perceived as places where one could have a better life; because of better opportunities, higher salaries, better services, and better lifestyles. The perceived better conditions attract poor people from rural areas. People move into urban areas mainly to seek economic opportunities. In rural areas, often on small family farms, it is difficult to improve one's standard of living beyond basic sustenance. Farm living is dependent on unpredictable environmental conditions, and during of drought, flood or pestilence, survival becomes extremely problematic. Cities, in contrast, are known to be places where money, services and wealth are centralised. Cities are places where fortunes are made and where social mobility<sup>1</sup> is possible. Businesses that generate jobs and capitals are usually located in urban areas. Whether the source is trade or tourism, it is also through the cities that foreign money flows into a country. People living on a farm may wish to move to the city and try to make enough money to send back home to their struggling family.

In the cities, there are better basic services as well as other specialist services that are not found in rural areas. There are more job opportunities and a greater variety of jobs in the cities. Health is another major factor. People, especially the elderly are often forced to move to cities where there are doctors and hospitals that can cater for their health needs. Other factors include a greater variety of entertainment (restaurants, movie theatres, theme parks, etc.) and a better quality of education. Due to high populations, urban areas can also have much more diverse social communities allowing others to find people like them.

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<sup>1</sup> Change in an individual's social class position (upward or downward) throughout the course of their life either between their own and their parents' social class (inter-generational mobility) or over the course of their working career (intra-generational mobility).



**Fig. 2.1** Projected percentage increase in urban population 2000–2030 (United Nations 2002)

These conditions are heightened during times of change from a pre-industrial society to an industrial one. At this transition time many new commercial enterprises are made possible, thus creating new jobs in cities. It is also a result of industrialisation that farms become more mechanised, putting many farm labourers out of work. Developing nations are currently passing through the process of industrialisation. As a result, growth rate of urban population is very high in these countries comparing industrialised countries.

In industrialised countries the future growth of urban populations will be comparatively modest since their population growth rates are low and over 80% of their population already live in urban areas. In contrast, developing countries are in the middle of the transition process, when urban population growth rates are very high. According to the United Nations report (UNFPA 2007), the number and proportion of urban dwellers will continue to rise quickly (Fig. 2.1). Urban global population will grow to 4.9 billion by 2030. In comparison, the world's rural population is expected to decrease by some 28 million between 2005 and 2030. At the global level, all future population growth will thus be in towns and cities; most of which will be in developing countries. The urban population of Africa and Asia is expected to be doubled between 2000 and 2030.

This huge growth in urban population may force to cause uncontrolled urban growth resulting in sprawl. The rapid growth of cities strains their capacity to provide services such as energy, education, health care, transportation, sanitation, and physical security. Since governments have less revenue to spend on the basic upkeep of cities and the provision of services, cities become areas of massive sprawl and serious environmental problems.

### ***2.2.2 Independence of Decision***

The competitors (government and/or private) hold a variety of expectations about the future and a variety of development demands. Often these competitors can take decisions at their own to meet their future expectations and development demands.

This is especially true if the city lacks a master plan as a whole. This independence ultimately results in uncoordinated, uncontrolled and unplanned development (Harvey and Clark 1965).

### ***2.2.3 Economic Growth***

Expansion of economic base (such as higher per capita income, increase in number of working persons) creates demand for new housing or more housing space for individuals (Boyce 1963; Giuliano 1989; Bhatta 2009b). This also encourages many developers for rapid construction of new houses. Rapid development of housing and other urban infrastructure often produces a variety of discontinuous uncorrelated developments. Rapid development is also blamed owing to its lack of time for proper planning and coordination among developers, governments and proponents.

### ***2.2.4 Industrialisation***

Establishment of new industries in countryside increases impervious surfaces rapidly. Industry requires providing housing facilities to its workers in a large area that generally becomes larger than the industry itself. The transition process from agricultural to industrial employment demands more urban housing. Single-storey, low-density industrial parks surrounded by large parking lots are one of the main reasons of sprawl. There is no reason why light industrial and commercial land-uses cannot grow up instead of out, by adding more storeys instead of more hectares. Perhaps, industrial sprawl has happened because land at the urban edge is cheaper.

### ***2.2.5 Speculation***

Speculation about the future growth, future government policies and facilities (like transportation etc.) may cause premature growth without proper planning (Clawson 1962; Harvey and Clark 1965). Several political election manifestos may also encourage people speculating the direction and magnitude of future growth. Speculation is sometimes blamed for sprawl in that speculation produces withholding of land for development which is one reason of discontinuous development.

### ***2.2.6 Expectations of Land Appreciation***

Expectations of land appreciation at the urban fringe cause some landowners to withhold land from the market (Lessinger 1962; Ottensmann 1977). Expectations may vary, however, from landowner to landowner, as does the suitability of land

for development. The result is a discontinuous pattern of development. The higher the rate of growth in a metropolitan area, the greater the expectations of land appreciation; as a result, more land will be withheld for future development.

### ***2.2.7 Land Hunger Attitude***

Many institutions and even individuals desire for the ownership of land. Often these lands left vacant within the core city area and makes infill policies unsuccessful (Harvey and Clark 1965). As a result the city grows outward leaving the undeveloped land within the city.

### ***2.2.8 Legal Disputes***

Legal disputes (e.g., ownership problem, subdivision problem, taxation problem, and tenant problem) often causes to left vacant spaces or single-storied buildings within the inner city space. This also causes outgrowth leaving the undeveloped land or single-storied buildings within the city.

### ***2.2.9 Physical Geography***

Sometimes the sprawl is caused because of unsuitable physical terrain (such as rugged terrain, wetlands, mineral lands, or water bodies, etc.) for continuous development (Fig. 2.2). This often creates leap-frog development sprawl (Harvey and Clark 1965; Barnes et al. 2001). Important to mention that in many instances these problems cannot be overcome and therefore should be overlooked.



**Fig. 2.2** Unsuitable physical terrain prohibits continuous development

### ***2.2.10 Development and Property Tax***

Generally, the costs involved in development of community-infrastructure and public services are higher in the countryside rather than the core city (refer Sect. 2.3.1). The maintenance costs of public services are also higher in the countryside. Therefore, the development and property tax should be higher at the periphery of the city. However, generally these taxes are independent of location and even in many instances these taxes are lower in the periphery comparing the core city. The problem is that local tax systems usually require developers to pay only a fraction of the community-infrastructure and public-service costs associated with their projects, which makes development look artificially cheap and encourages urban expansion (Brueckner and Kim 2003). Underpricing of urban infrastructure encourages excessive spatial growth of cities, as shown by Brueckner (1997).

### ***2.2.11 Living and Property Cost***

Generally living cost and property cost is higher in the main city area than the countryside. This encourages countryside development. Harvey and Clark (1965) say ‘at the time of sprawl occurred, the cost was not prohibitive to the settler, (rather) it provided a housing opportunity economically satisfactory relative to other alternatives’. Generally majority of urban residents seek to settle within the core city, but lower living and property cost attract them to the countryside.

### ***2.2.12 Lack of Affordable Housing***

It is similar to *living and property cost* and another reason of urban sprawl. Affordable housing is a term used to describe dwelling units whose total housing costs are deemed ‘affordable’ to those that have a median household income.<sup>2</sup> A common measure of community-wide affordability is the number of homes that a household with a certain percentage of median income can afford. For example, in a perfectly balanced housing market, the median household (and the half of the households which are wealthier) could officially afford the median housing option, while those poorer than the median income could not afford the median home. 50% affordability for the median home indicates a balanced market. Lack of affordable housing within the city forces people to set their residences in the countryside.

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<sup>2</sup> The median household income (or median income) is commonly used to provide data about geographic areas and divides households into two equal segments with the first half of households earning less than the median household income and the other half earning more. The median income is considered by many statisticians to be a better indicator than the average household income as it is not dramatically affected by unusually high or low values.

### ***2.2.13 Demand of More Living Space***

In many developing countries, residents of the core city lack sufficient living space. This encourages countryside development for more living space. People can buy more living space in the countryside than in the inner city, since the cost of property is less in the countryside. However, consumption of more living space not always causes sprawl. Population density is a major concern in this issue. Cities in developing countries are three times denser than the cities in developed countries (Acioly and Davidson 1996). Therefore, higher per capita consumption of built-up area (or living space) is desired in many instances. In such cases, higher per capita consumption of living space may indicate better and extended living facilities within the confines of compact urban growth. However, if the demand of more living space forces rapid low-density development in the countryside then it must be an indication of sprawl.

### ***2.2.14 Public Regulation***

Generally outside of the main city is lesser controlled and loosely regulated. As a result, many developers and individuals find these places more suitable for new construction (Harvey and Clark 1965). Loosely regulated public regulations also fail to control the new construction in a compact and sustainable manner, and in many instances developers do not bother about the government planning policies.

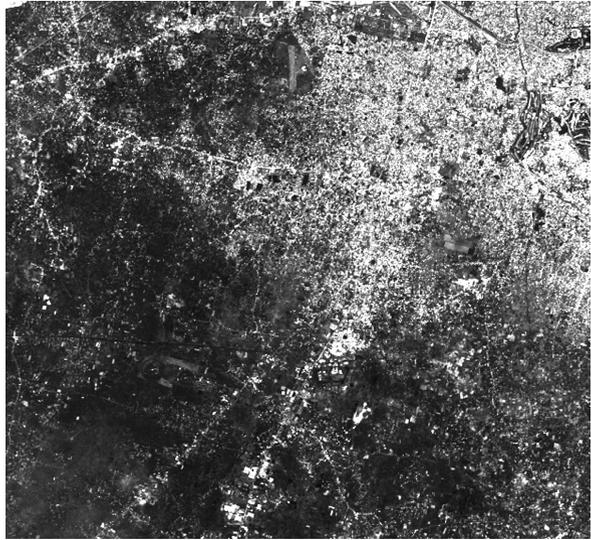
### ***2.2.15 Transportation***

Transportation routes open the access of city to the countryside and responsible for linear branch development (Fig. 2.3). The construction of expressways and highways cause both congestion in the city and rapid outgrowth (Harvey and Clark 1965). Roads are commonly considered in modelling and forecasting urban sprawl (Cheng and Masser 2003; Yang and Lo 2003), because they are a major catalyst of sprawl. Important to realise that transportation facilities are essential to cities and its neighbourhoods. Development of urban economy and thereby job opportunities are directly dependent on the transportation facilities. Therefore, transportation facilities can never be suppressed; rather initiatives to impede linear branch development by means of government policies and regulations should be practiced.

### ***2.2.16 Road Width***

Governments do not allow construction of high-rise buildings if the site can not be easily accessed. Narrow roads within the city area restrict construction of high-rise buildings resulting in waste of vertical space. This wastage of vertical space transformed into horizontal growth. This is a common problem to very old cities in

**Fig. 2.3** Construction of roads encourages linear branch sprawl



many developing countries where past planners failed to visualise the future needs and did not plan wider roads. Recent road-widening policies that are taken in many developing countries have failed owing to their economic (huge money is required to compensate the road-side house owners) and political constrains.

### ***2.2.17 Single-Family Home***

In many instances, individuals built a single-family home (rather than multi-family high-rise building) (Fig. 2.4). This also wastes vertical space significantly resulting in horizontal growth. Single-family residences increase the size of a city in multiple magnitudes.



**Fig. 2.4** Single-family homes waste vertical space

### ***2.2.18 Nucleus Family***

Commonly, percapita consumption of carpet area in nucleus family is higher than the joint family. For example, a common dining space is shared by all the family members in a joint family. Transition from joint family to nucleus family also creates demand of new housing for individuals.

### ***2.2.19 Credit and Capital Market***

Credit and loan facility, low interest rate, etc. are also responsible for rapid urban growth in advance. In this sense, people can buy homes before achieving the financial capability. Therefore, the growth will occur in advance than actually supposed to be.

### ***2.2.20 Government Developmental Policies***

Restrictive land-use policies in one political jurisdiction may lead development to 'jump' to one that is favourably disposed toward development or is less able to prevent or control it (Barnes et al. 2001). Often dissimilarities in development regulations, land-use policies, and urban services among the neighbouring municipalities (or local governments) may cause discontinuous development.

### ***2.2.21 Lack of Proper Planning Policies***

Lack of consistent and well-experimented planning policies may also cause urban sprawl. A city may be planned with exclusive zoning policies; this means separation of residential, commercial, industrial, office, institutional, or other land uses. Completely separate zoning created isolated islands of each type of development. In most cases, the automobile had become a requirement for transportation between vast fields of residentially zoned housing and the separate commercial and office strips, creating issues of automobile dependency and more fossil fuel consumption and thereby pollution. A mixed land-use policy is preferred to fight against sprawl.

### ***2.2.22 Failure to Enforce Planning Policies***

Having a proper planning policy is not enough, rather its successful implementation and enforcement is more important. Unsuccessful enforcement of land-use plans is one of the reasons of sprawl in developing countries, since the enforcement is often corrupt and intermittent in these countries.

### ***2.2.23 Country-Living Desire***

Residents of countryside are often former urbanites who desire the solitude and perceived amenities of country-living as rural retreats. Despite traffic congestion and long commutes to work, moving to the suburbs remains a goal for many city residents who perceive quality of life in the suburbs as better. Unless this perception changes and the conditions of urban life improve, sprawl development will continue as the flight from cities to suburbs continues (Barnes et al. 2001).

### ***2.2.24 Housing Investment***

Often urbanites purchase second homes in the countryside as future investments (Barnes et al. 2001). This encourages the developers for construction at the countryside in advance. These homes often left vacant but the government is forced to maintain urban facilities and services in a low-density area. Low interest rate and high housing demand make the countryside-housing investment more attractive.

### ***2.2.25 Large Lot Size***

Large lot (or plot) size is another reason of sprawl. Large-lot residents utilise a portion of their land for construction purposes leaving other portions as non-developed (Fig. 2.5). Although this problem is mainly associated with developed countries; however, also in the developing countries, residents in the countryside generally prefer to have a large individual lot.



**Fig. 2.5** Large-lot residents utilise a portion of their land for construction

### 2.3 Consequences of Urban Growth and Sprawl

Consequences of urban growth may have both positive and negative impacts; however, negative impacts are generally more highlighted because this growth is often uncontrolled or uncoordinated and therefore the negative impacts override the positive sides. Positive implications of urban growth include higher economic production, opportunities for the underemployed and unemployed, better life because of better opportunities and better services, and better lifestyles. Urban growth can extend better basic services (such as transportation, sewer, and water) as well as other specialist services (such as better educational facilities, health care facilities) to more peoples. However, in many instances, urban growth is uncontrolled and uncoordinated resulting in sprawl. As a result, the upside impacts vanish inviting the downsides.

In the developed countries, during the nineteenth and early twentieth centuries, urbanisation resulted from and contributed to industrialisation. New job opportunities in the cities motivated the mass movement of surplus population away from the villages. At the same time, migrants provided cheap, plentiful labour for the emerging factories. Currently, due to movements such as globalisation, the circumstances are similar in developing countries. The concentration of investments in cities attracts large number of migrants looking for employment, thereby creating a large surplus labour force, which keeps wages low. This situation is attractive to foreign investment companies from developed countries who can produce goods for far less than if the goods were produced where wages are higher. Thus, one might wonder if urban poverty serves a distinct function for the benefit of global capital.

Developed and developing countries of the world differ not only in the number of people living in cities, but also in the way in which urbanisation is occurring. In many megacities of developing world, urban sprawl is a common problem and a substantial amount of city dwellers live in slums within the city or in urban periphery in poverty and degraded environment (Fig. 2.6). These high-density settlements are often highly polluted owing to the lack of urban services, including running water, sewer, trash pickup, electricity or paved roads. Nevertheless, cities provide poor people with more opportunities and greater access to resources to transform their situation than rural areas.



**Fig. 2.6** Housing of poor urban people

One of the major effects of rapid urban growth is sprawl that increases traffic, saps local resources, and destroys open space. Urban sprawl is responsible for changes in the physical environment, and in the form and spatial structure of cities. In many countries including the developed countries like United States, poorly planned urban development is threatening the environment, health, and quality of life. In communities across the world, sprawl is taking a serious toll.

Evidence of the environmental impacts of sprawl continues to mount. Kirtland et al. (1994) report that the impact of urban land on environmental quality is much larger than its spatial extent would imply. The consequences and significance of sprawl, good or ill, are evaluated based on its socioeconomic and environmental impacts. Often these are overlapping or one may have several indirect impacts. However, major consequences of urban sprawl can be summarised as follows.

### ***2.3.1 Inflated Infrastructure and Public Service Costs***

Sprawl is usually accepted as being inordinately costly to its occupants and to society (Harvey and Clark 1965). Sprawl is blamed due to its environmental cost and economic cost (Buiton 1994). Cities have experienced an increase in demand for public services and for the maintenance and improvement of urban infrastructures (Barnes et al. 2001) such as fire-service stations, police stations, schools, hospitals, roads, water mains, and sewers in the countryside. Sprawl requires more infrastructures, since it takes more roads, pipes, cables and wires to service these low-density areas compared to more compact developments with the same number of households. Other services such as waste and recyclables collection, mail delivery and street cleaning are more costly in low-density developments, while public transit is impractical because the rider density needed to support a transit service is not there.

*The Costs of Sprawl* and other studies have shown that development of neighbourhood infrastructure becomes less costly on a per-unit basis as density rises (refer Priest et al. 1977; Frank 1989). As long as developers are responsible for the full costs of neighbourhood infrastructure, and pass such costs on to homebuyers and other end-users of land, lower-density development patterns will meet the test of economic efficiency (at least with respect to infrastructure costs). Where inefficiency is more likely to arise is in the provision of community-level infrastructure. Inefficiency may also arise in the operation and maintenance of infrastructure, and in the provision of public services. Because people are more dispersed and no longer residing in centralised cities, the costs of community infrastructure and public services in suburban areas increases (Brueckner 2000; Heimlich and Anderson 2001; Pedersen et al. 1999; Wasserman 2000). These costs tend to be financed with local taxes or user fees that are generally independent of location, causing remote development to be subsidised.

It may be mentioned that from the standpoint of community-level infrastructure, costs do not vary so much with residential density but with the degree of clustering and/or proximity to existing development (HCPC 1967; Stone 1973; RERC

1974; Downing and Gustely 1977; Peiser 1984). So, too, the costs of public services (Archer 1973; RERC 1974; Downing and Gustely 1977; Peiser 1984).

### ***2.3.2 Energy Inefficiency***

Higher densities mean shorter trips but more congestion. Newman and Kenworthy (1988) find that the former effect overwhelms the latter. Even though vehicles are not as fuel-efficient in dense areas owing to traffic congestion, fuel consumption per capita is still substantially less in dense areas because people drive so much less. Urban sprawl causes more travel from the suburbia to the central city and thus more fuel consumption. Furthermore, it also causes traffic congestion. More cars on the roads driving greater distances are a recipe for traffic gridlock resulting in more fuel consumption.

With electricity, there is a cost associated with extending and maintaining the service delivery system, as with water, but there also is a loss in the commodity being delivered. The farther from the generator, the more power is lost in distribution.

### ***2.3.3 Disparity in Wealth***

There is marked spatial disparity in wealth between cities and suburbs; and sprawled land development patterns make establishing and using mass transit systems difficult (Benfield et al. 1999; Kunstler 1993; Mitchell 2001; Stoel 1999). Sprawl is also implicated in a host of economic and social issues related to the deterioration of urban communities and the quality of life in suburbia (Wilson et al. 2003). In many cases private utility systems serving the main segment of the settled area cannot be expanded for technical and financial reasons. Urban sprawl often occurs in peripheral areas without the discipline of proper planning and zoning; as a result, it blocks the ways of future possible quality services.

### ***2.3.4 Impacts on Wildlife and Ecosystem***

In areas where sprawl is not controlled, the concentration of human presence in residential and industrial settings may lead to an alteration of ecosystems patterns and processes (Grimm et al. 2000). Development associated with sprawl not only decreases the amount of forest area (Macie and Moll 1989; MacDonald and Rudel 2005), farmland (Harvey and Clark 1965), woodland (Hedblom and Soderstrom 2008), and open space but also breaks up what is left into small chunks that disrupt ecosystems and fragment habitats (Lassila 1999; McArthur and Wilson 1967; O'Connor et al. 1990). The reach of urban sprawl into rural natural areas such as woodlands and wetlands ranks as one of the primary forms of wildlife habitat loss. Roads, power lines, subdivisions and pipelines often cut through natural areas, thereby fragmenting wildlife habitat and altering wildlife movement patterns



**Fig. 2.7** Fragmentation of wildlife habitat

(Fig. 2.7). The fragmentation of a large forest into smaller patches disrupts ecological processes and reduces the availability of habitat for some species. Some forest fragments are too small to maintain viable breeding populations of certain wildlife species.

### ***2.3.5 Loss of Farmland***

Urbanisation generally, and sprawl in particular, contribute to loss of farmlands and open spaces (Berry and Plaut 1978; Fischel 1982; Nelson 1990; Zhang et al. 2007). Urban growth, only in the United States, is predicted to consume 7 million acres of farmland, 7 million acres of environmentally sensitive land, and 5 million acres of other lands during the period 2000–2025 (Burchell et al. 2005). This case is enough to visualise the world scenario.

Provincial tax and land-use policies combine to create financial pressures that propel farmers to sell land to speculators. Low prices of farm commodity in global markets often mean it is far more profitable in the long term for farmers to sell their land than to continue farming it. In addition, thousands of relatively small parcels of farmland are being severed off to create rural residential development. Collectively, these small lots contribute to the loss of hundreds of hectares of productive agricultural land per year.

The loss of agricultural land to urban sprawl means not only the loss of fresh local food sources but also the loss of habitat and species diversity, since farms include plant and animal habitat in woodlots and hedgerows. The presence of farms on the rural landscape provides benefits such as greenspace, rural economic stability, and preservation of the traditional rural lifestyle.

### ***2.3.6 Increase in Temperature***

Positive correlation between land surface temperature and impervious surface clearly indicates temperature increase in the sprawled area (Weng et al. 2007; Wang

et al. 2003). On warm days, urban areas can be 6–8°F (3.5–4.5°C) warmer than surrounding areas, an effect known as an *urban heat island* (Frumkin 2002) (Fig. 2.8). The heat island effect is caused by two factors. First, dark surfaces such as roadways and rooftops efficiently absorb heat from sunlight and reradiate it as thermal infrared radiation; these surfaces can reach temperatures of 50–70°F (28–39°C) higher than surrounding air. Second, urban areas are relatively devoid of vegetation, especially trees; that would provide shade and cool the air through *evapotranspiration*.<sup>3</sup> As cities sprawl outward, the heat island effect expands, both in geographic extent and in intensity. This is especially true if the pattern of development features extensive tree-cutting and road construction.

Furthermore, dispersed metropolitan expansion involves a positive feedback loop that may aggravate the heat island effect. Sprawling metropolitan areas, with greater travel distances, generate a large amount of automobile travel. This, in turn, results in more fuel combustion, with more production of carbon dioxide, and consequent contributions to global climate change. Global climate change, in turn, may intensify the heat island effect in metropolitan areas. Thus, not only does the morphology of metropolitan areas contribute to warming, but so may the greenhouse gas production that results from increased driving.

The number of habitants is a decisive factor conditioning the occurrence of urban heat island. Figure 2.9 shows increased city size (represented by circles) with increasing number of habitants is responsible for increasing urban temperature.

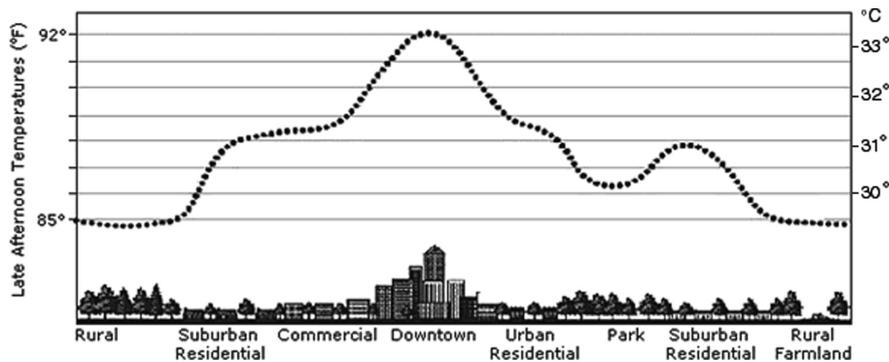
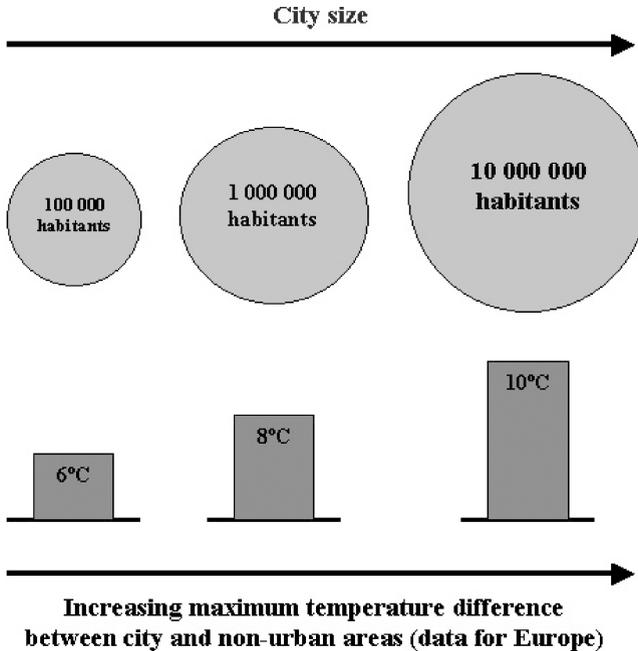


Fig. 2.8 An urban heat island profile (Klinenberg 2002)

<sup>3</sup> Evapotranspiration is a term used to describe the sum of evaporation and plant transpiration from the earth’s land surface to atmosphere.



**Fig. 2.9** Increased city size and number of habitants cause increase in temperature  
(Source: <http://www.atmosphere.mpg.de>)

### 2.3.7 Poor Air Quality

Sprawl is cited as a factor of air pollution (Stone 2008), since the car-dependent lifestyle imposed by sprawl leads to increases in fossil fuel consumption and emissions of greenhouse gases (Stoel 1999). Urban sprawl contributes to poorer air quality by encouraging more automobile use, thereby adding more air pollutants such as carbon monoxide, carbon dioxide, ground-level ozone, sulphur dioxide, nitrogen oxides, volatile organic carbons, and microscopic particles (Frumkin 2002). These pollutants can inhibit plant growth, create smog and acid rain, contribute to global warming, and cause serious human health problems. Apparently it seems that low-density urban growth or sprawl can provide better environmental condition and fresh air, but Kahn and Schwartz (2008) found that urban air pollution progress despite sprawl.

Increased temperature in urban areas also has indirect effects on air pollution. As the temperature rises, so does the demand for energy to power fans, air coolers, water coolers, and air conditioners; requiring power plants to increase their output. The majority of power plants burn fossil fuels, so increased demand of power in summer results in higher emissions of the pollutants they generate, including carbon dioxide, particulate matter, sulphur oxides, nitrogen oxides, and air toxics. Furthermore,

ozone formation from its precursors, nitrogen oxides and hydrocarbons, is enhanced by heat (Frumkin 2002).

### ***2.3.8 Impacts on Water Quality and Quantity***

Sprawl also has serious impacts on water quality and quantity. With miles of roads, parking lots and houses having paved over the countryside, rainwater and snowmelt are unable to soak into the ground and replenish the groundwater aquifers.

Urban growth and sprawl lead to an increasing imperviousness, which in turn induces more total runoff volume. So urban areas located in flood-prone areas are exposed to increased flood hazard, including inundation and erosion (Jacquin et al. 2008). As new development continues in the periphery of the existing urban landscape, the public, the government, planners and insurance companies are more and more concerned by flooding disasters and increasing damages (Wisner et al. 2004; Jacquin et al. 2008).

In the urban area, water runs off into storm sewers and ultimately into rivers and lakes. Extra water during heavy rain can dramatically increase the rate of flow through wetlands and rivers, stripping vegetation and destroying habitats along riverbanks. It can also cause damaging floods downstream and lead to an increase in water pollution from runoff contaminated with lawn and garden chemicals, motor oil and road salt. Widely dispersed development requires more pavements that cause more urban runoff that pollutes waterways (Lassila 1999; Wasserman 2000). These pollutants can be absorbed by humans when they eat contaminated fish from affected water-bodies and when they drink from contaminated surface water or groundwater sources.

In addition, heavy rainstorms occurring in cities and towns with inadequate systems for managing stormwater can cause untreated human sewage to enter waterways (*combined sewer overflow*).

### ***2.3.9 Impacts on Public and Social Health***

One of the original motivations for migration to the suburbs was access to nature. People generally prefer to live with trees, birds, and flowers; and these are more accessible in the suburbs than in denser urban areas. Moreover, contact with nature may offer benefits beyond the purely aesthetic; it may benefit both mental and physical health. In addition, the sense of escaping from the turmoil of urban life to the suburbs, the feeling of peaceful refuge, may be soothing and restorative to some people. In these respects, there may be health benefits to suburban lifestyles (Frumkin 2002). However, sprawl is generally blamed for its negative impacts on public health (refer Frumkin 2002; Savitch 2003; Yanos 2007; Sturm and Cohen 2004).

One of the cardinal features of sprawl is driving, reflecting a well-established, close relationship between lower density development and more automobile travel.

Automobile use offers extraordinary personal mobility and independence. However, it is also associated with health hazards, including air pollution, motor vehicle crashes, and pedestrian injuries and fatalities (Frumkin 2002). Air pollution causes severe breathing problems, skin diseases, and other health problems. The effects of air pollution on the health of human and other living species are perhaps known to everyone.

Sprawl is blamed for driving out local downtown commerce by attracting consumers to larger, regional malls and restaurants (Pedersen et al. 1999). Sprawl results waste in time of passing vacant land enroute from central city to the sprawled suburb (Harvey and Clark 1965), giving rise to more traffic congestion (Brueckner 2000; Ewing 1997; Pedersen et al. 1999; Wasserman 2000) and reduced social interaction. Since sprawl is so car-dependent, walking or cycling opportunities (and the chances they bring for social interaction) diminish, while driving distances tend to lengthen dramatically. Long commutes to and from work heighten psychological stress. As people spend more time on more crowded roads, an increase in these psychological health-outcomes might be expected. One possible indicator of such problems is road rage, defined as 'events in which an angry or impatient driver tries to kill or injure another driver after a traffic dispute' (Rathbone and Huckabee 1999). Longer travel-time also reduces time available for work, leisure, and family (Wilson et al. 2003). Families who can not afford housing to live within the city may suffer from distress that may cause negative impacts on a community's overall health.

Rates of automobile fatalities and injuries per driver and per mile driven have fallen thanks to safer cars and roads, seat belt use, laws that discourage drunk driving, and other measures, but the absolute toll of automobile crashes remains high. The relationship between sprawl and motor vehicle crashes is complex. At the simplest level, more driving means greater exposure to the dangers of the road, translating to a higher probability of a motor vehicle crash. Suburban roads may be a particular hazard, especially major commercial thoroughfares and 'feeder' roads that combine high speed, high traffic volume, and frequent 'curb cuts' for drivers to use in entering and exiting stores and other destinations (Frumkin 2002). The most dangerous stretches of road were those built in the style that typifies sprawl: multiple lanes, high speeds, no sidewalks, long distances between intersections or crosswalks, and roadways lined with large commercial establishments and apartments blocks. Walking offers important public health benefits, but safe and attractive sidewalks and footpaths are needed to attract walkers and assure their safety that is often suffered by sprawled development.

Urban areas are warmer than rural. Heat is of concern because it is a health hazard. Relatively benign disorders include heat syncope, or fainting; heat edema, or swelling, usually of dependent parts such as the legs; and heat tetany, a result of heat-induced hyperventilation. Other effects include heat cramps, heat exhaustion vomiting, weakness, and mental status changes. The most serious of the acute heat-related conditions is heat stroke. Frumkin (2002) discussed these urban health issues in detail.

From the perspective of social health, low-density development is blamed for reducing social interaction and threatening the ways that people live together (Ewing

1997; Putnam 2000). Residents may also lose their sense of community as their town's population swells dramatically.

### ***2.3.10 Other Impacts***

Exurban development can place additional burdens on rural economic/land-use activities such as forestry, mining, and farming, since the values of exurbanites may clash with those of traditional users regarding the most suitable uses of rural lands.

Urban sprawl, a potential manifestation of development, has its negative impacts in coastal regions also, where beach-oriented tourism and amenity-driven population growth and land development are prominent (Crawford 2007).

Sprawl also includes aesthetic impacts such as more ugly and monotonous suburban landscapes. For other several indirect impacts of sprawl please refer Barnes et al. (2001) and Squires (2002).



<http://www.springer.com/978-3-642-05298-9>

Analysis of Urban Growth and Sprawl from Remote Sensing  
Data

Bhatta, B.

2010, XX, 172 p., Hardcover

ISBN: 978-3-642-05298-9